Gartner
Lee
Associates Limited

Consulting
Engineering
Geologists and
Hydrogeologists

Toronto-Buttonville Airport ■ Markham, Ontario ■ L3P 3J9 ■ 416-477-8400

STUDY OUTLINE

PRIMARY ENVIRONMENTAL INFORMATION
PART I -
GEOLOGICAL/HYDROGEOLOGICAL INVENTORY

FOR

FACILITIES DEVELOPMENT PROCESS
OF
ONTARIO WASTE MANAGEMENT CORPORATION

MAY, 1982

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1.0 INTRODUCTION:

1.1 BACKGROUND:

The Ontario Waste Management Corporation (OWMC) has implemented a 'Facilities Development Process' to establish facilities for the treatment and disposal of hazardous liquid industrial waste and other hazardous waste in Ontario. The first phase of the process involves the collection and analysis of "Primary" engineering, planning and environmental information basic to the evaluation of various systems options.

This study outline deals with one component of the Primary Environmental Information -- *the geological/hydrogeological inventory.* It was apparent early in the facilities development process that a provincial geological/hydrogeological inventory of Ontario lands would be necessary and work began on this inventory early in 1982. Study outlines dealing with other environmental inventories, i.e. surface water, climatology, environmentally sensitive areas, archaeology, will be submitted as separate documents. These other outlines, together with this one will provide a complete description of the Phase 1 environmental studies.

1.2 STUDY OBJECTIVES:

This is the first study in the Primary Environmental Information package. Its basic objective is

to describe the major geological/hydrogeological features of southern Ontario to allow preliminary evaluation of lands for secure landfilling and other treatment systems options.

To achieve this objective, information is being collected and presented in a fashion which will assist in testing the capabilities of the disposal system being considered and of the lands in question, to safely receive solid residues. Data collection and interpretation has been geared to answering three fundamental questions which will aid in testing systems options:

(i) What is the natural capability of the geological/hydrogeological setting to contain and attenuate possible contaminants?;

(ii) What is the predictability of the behaviour of possible ground water contaminants in the hydrogeological setting?; and

(iii) In the event of an unforeseen accident, what degree of lead-time does the hydrogeological setting afford before remedial or public safety measures may be implemented?

The results of this Phase I Geological/Hydrogeological Inventory will provide the framework for further more

detailed review in map units showing promise for disposal of solid residues. Also, the information will be useful in describing preliminary engineering geological conditions throughout the province for other treatment systems options.

1.3 SCOPE:

This is the first proposal for the collection of Primary Environmental Information. It describes the methodology and personnel involved in completing a *Geological/Hydrogeological Inventory* of Ontario.

The study area is provincial in scale and includes all lands in Ontario south of latitude 46^{0}N (i.e. south of North Bay).

While the inventory is general in scope owing to the province-wide scale of the study, it will provide a reliable data base to be combined with other primary environmental, engineering and planning information to identify feasible facilities options.

At this time, there is a lack of good information on quantities and characteristics of residues from the treatment facility. Owing to the general nature of this province-wide inventory, these unknowns are not expected to create serious problems in our interpretation of preliminary data.

2.0 DESCRIPTION OF PART I TASKS:

2.1 DATA ASSEMBLAGE:

The first task will be the collection of all relevant information required to identify and evaluate the various regions of the province. These will include Ministry of the Environment Basin Studies and ground water reports, drift thickness maps, Quaternary and bedrock geology maps, physiographic maps, previous waste management terrain studies, Ministry of Natural Resources engineering terrain studies, water well and gas well records.

We have designed an information management system to handle these resource data. Specially designed Data Resource Sheets will be used to record the following factors for each physiographic region of the province:

- Geology
- Hydrogeology

All backup information will be kept on permanent file.

2.2 PHYSIOGRAPHIC EVALUATION:

Chapman and Putnam's "Physiography of Southern Ontario" will be used as the basis for the physiographic evaluation. Their map -- at an approximate scale of 1:250,000 -- provides an ideal base for identifying and evaluating the

gross regions of the province. Each part of the provincial study area will be examined and Data Resource Sheets prepared.

2.3 Geological Evaluation:

The geological evaluation will include detailed Quaternary geology reports, aggregate assessment reports, topographic maps, bedrock geology reports and published geological sections showing stratigraphic relationships.

Many of the senior staff at Gartner Lee Associates Limited have considerable knowledge of the geological history and conditions within the province. Their subjective opinions of these geological conditions will be melded into the program at this stage.

Geological information for all regions will be recorded on the Data Resource Sheets and further evaluated for their hydrogeological characteristics.

2.4 Hydrogeological Evaluation:

The next task is to evaluate the hydrogeological characteristics of Southern Ontario lands. This will be done by referring to Ministry of the Environment water supply reports and basin studies (where available), selected water well data, regional and county hydrogeological waste management studies. As well, preliminary assessment of

attenuation properties will be completed and established flow system analysis techniques will be applied.

2.5 Collation - Data Resource Sheets:

At this stage every part of the provincial study area will have been evaluated physiographically, geologically and hydrogeologically and examined in a reconnaissance fashion for its significance in relation to a secure landfill and other treatment systems options.

We propose to file all of the data in our information management system so that information for any region within the provincial study area can be retrieved, and form the basis of further, more intensive studies at a later stage.

Lands of similar geological/hydrogeological characteristics will be grouped and portrayed on a general summary map.

3.0 STUDY TEAM AND TASK ALLOCATIONS:

Gartner Lee Associates Limited will act as the managing consultant for the Primary Environmental Information inventory task. Common to the supervision and management of the Primary Environmental Information portion of the Facilities Development Process will be:

- Mr. P. Lee, P.Eng. who will act as Partner-in-Charge of the study and Mr. E.G. Anderson, P.Eng. who will act as Project Director.

- Mr. D.S. Osmond, B.Sc., Agr., who will act as Project Manager for the collection of all Primary Environmental Information.

Specifically involved in this Part I (Geology/Hydrogeology) task of the Primary Environmental Information task will be:

- Mr. D. Jagger, P.Eng. who will act as Project Supervisor, Doug will work closely with Mr. A.J. Cooper, M.Sc. whose experience in Quaternary Geology of the province will be most valuable for this project.

- Other Gartner Lee Associates Limited staff, many of whom have completed pertinent studies in different regions of the province will be called upon for support to the study team as required.

Curricula vitae of key staff members are provided in the appendix of this proposal.

We intend to continue our policy of close liaison with Ontario Waste Management Corporation staff throughout the Primary Environmental Information inventory. Staff from OWMC will be kept well informed of our progress and of key decision points in the study. As well, we will be interfacing frequently with Mr. W.D. Goodings and key Proctor & Redfern Limited staff as the study progresses. Mr. W.D. Goodings and Mr. J.F. Gartner will serve as principal advisors.

PATRICK K. LEE, P. Eng.
M.A.Sc., P.Eng., F.G.A.C.
Consulting Engineering Geologist

PROFILE

1955-1959	- B.A. (Honours), University of Toronto, Honours Geology
1959	- Geological Mapping, Ontario Department of Mines
1959-1961	- Geologist, Soils Engineer - Dominion Soils Limited
1961-1966	- Associate Head of Science - Burnhamthorpe Collegiate,Etobicoke
1966-1968	- M.A.Sc., University of Waterloo, Soil Mechanics & Civil Engineering
1968-1972	- Chief Engineering Geologist - Terra Scan Limited
1972-Present	- Principal - Gartner Lee Associates Limited
1974	- Designated Consulting Engineer, Ontario
1976	- Course - University of Missouri-Rolla - Ground Water Analysis and Design of Dewatering Systems
1977	- Course - Princeton University, N.J. Investigation of Ground Water Pollution

EXPERIENCE

Mr. Lee is a founding partner of Gartner Lee Associates Limited and has extensive experience in contaminant hydrogeology and gas migration, as well as other related disciplines. These disciplines include engineering geology, geotechnical engineering, airphoto interpretation and geochemistry. He also has considerable experience as an expert witness at hearings.

Throughout his technical career, Mr. Lee has been active in many waste disposal projects both in Ontario and other parts of Canada and the United States. He has consulted to the Federal Government on liquid and solid waste disposal and is the principal-in-charge of research work for the deep disposal of radioactive wastes for Atomic Energy of Canada Limited.

Much of his experience has been gained in Ontario. Mr. Lee has carried out a number of regional site selection studies including Hamilton-Wentworth, Niagara, Peel, Northumberland to mention a few.

E. GRANT ANDERSON P. Eng.
B.Sc., F.G.A.C.
Consulting Hydrogeologist

PROFILE

1966-1970	- B.Sc., Queen's University, Engineering Geology
1970-1972	- Engineering Geologist, Terra Scan Limited
1972-1975	- Engineering Geologist, Gartner Lee Associates Limited
1973-1975	- Credit to Masters, University of Waterloo - Ground Water Geology and Advanced Hydrogeology
1975-1980	- Associate, Gartner Lee Associates Limited
1980-Present	- Principal, Gartner Lee Associates Limited
1976	- Audit, University of Waterloo, Field Techniques in Hydrogeology
1977	- Extension Course, University of Missouri-Rolla, Ground Water Analysis and the Design of Dewatering Systems
1978	- Designated Consulting Engineer, Ontario
1980	- Extension Course, Princeton University, Ground Water Pollution and Hydrology
1980	- Member, A.S.T.M. Committee D 34 on Waste Disposal

EXPERIENCE

Mr. Anderson is a Consulting Hydrogeologist and principal with the firm. He has developed an enviable reputation in the ground water investigation field as applied to waste disposal and in the study of gas migration from existing and closed facilities. As well, he has wide experience in areas of airphoto interpretation, geological engineering and terrain assessment.

As a principal with the firm, Mr. Anderson is in a review position and thus takes responsibility for technical and financial aspects of a large number of projects. Where required, he appears at hearings and court cases in support of projects which he has managed.

Mr. Anderson has recently appeared as an expert witness on behalf of Canadian concerns in the Hyde Park Landfill court case in New York State.. He has completed many regional and detailed hydrogeological studies within the province including Halton, South Cayuga, Ridge Landfill in Chatham, Kingston Township, City of Ottawa, City of Cornwall, CFB Borden, to mention a few projects.

DAVID S. OSMOND

B.Sc., Agr.

Aquatic Biologist

PROFILE

1963-1967	- B.Sc. (Agr.) - University of Guelph - Honours Zoology
1967-1969	- Biologist - Ontario Water Resources Commission (Toronto)
1969-1974	- Regional Biologist - O.W.R.C. and Ontario Ministry of the Environment (London)
1974-1976	- Chief, Water Resources Assessment - Ontario Ministry of the Environment - Southwestern Region
1976-1978	- Aquatic Biologist - Gartner Lee Associates Limited
1978-1981	- Senior Biologist - Gartner Lee Associates Limited
1981-Present	- Associate - Gartner Lee Associates Limited

EXPERIENCE

Mr. Osmond is an Associate of the company and an experienced scientist in his field of expertise. Throughout the years he has maintained his active interest in the taxonomy of macrobenthos with particular specialization in the aquatic oligochaetes. During the last 15 years he has gained enviable experience not only in aquatic biology, but in the interrelationships of all environmental factors.

He has both managed and been prime scientific investigator for a number of environmental projects including work for South Cayuga, Central Lake Ontario Conservation Authority, Upper Thames River Conservation Authority, Ministry of the Environment Industrial Waste Identification Study to mention a few.

AFFILIATIONS

• North American Benthological Society • Canadian Society of Environmental Biologists • American Society of Limnology and Oceanography • Pollution Control Association of Ontario • Ontario Association of Environmental Management • British Ecological Society

DOUGLAS E. JAGGER P. Eng.
B.A. Sc.
Civil Engineer

PROFILE

1964-1967	- Technologist and Chief Laboratory Technician - E.M. Peto Associates Ltd.
1967-1972	- B.A. Sc. - University of Waterloo - Civil Engineering
1972-1973	- Project Soils Engineer - Peto Associates Limited
1973-1977	- Project Engineer - Gartner Lee Associates Limited
1975	- Hydrogeology - University of Waterloo
1977-1980	- Senior Project Engineer - Gartner Lee Associates Limited
1978	- Dewatering Systems - University of Missouri-Rolla
1978	- Water Wells - Design and Construction - University of Wisconsin, Extension
1981-Present	- Associate, Gartner Lee Associates Limited
1982	- Rock Slope Engineering for Open-Pit Mines - Short Course

EXPERIENCE

Mr. Jagger, who is a registered professional engineer, has over 17 years experience in the consulting engineering field. His experience ranges from technical studies in hydrogeology, waste disposal and methane gas throughout the Province to project management and organization. As well, he has a solid training in airphoto interpretation, terrain assessment, and geotechnical engineering to supplement his civil engineering background.

As manager, Mr. Jagger is accustomed to organizing and directing both staff and projects. Early in his career, he was supervisor of a laboratory in a major soils consulting firm and was responsible for its operation. Since graduation, he has been project manager on many different projects.

As a technical expert, he personally carried out projects in his various fields of experience. Specifically, studies include work on many landfill sites throughout the Province, as related to both gas and leachate concerns. For example, he has worked on the regional landfill sites in Glanbrook, Halton, Peel and Oxford, on existing sites such as the Oakville Landfill Site.

ANDREW J. COOPER
B.Sc., M. Sc., F. G.A.C.
Geologist

PROFILE

1967-1971	- B.Sc. - Brock University - Geological Sciences
1969	- Student Geologist - Ontario Ministry of Natural Resources (O.M.N.R.)
1970	- Student Geologist, O.M.N.R.
1971	- Senior Geologist Assistant, O.M.N.R.
1971-1973	- University of Waterloo, Graduate Studies
1972	- Geological Survey of Canada
1973-1978	- Quaternary Geologist, Ontario Geological Survey - Engineering and Terrain Geology Section
1975	- M.Sc. - University of Waterloo - Geological Sciences
1978-1979	- Supervisor - Aggregate Resources Inventory Unit - Ontario Geological Survey
1979-Present	- Senior Geologist - Gartner Lee Associates Limited

EXPERIENCE

Mr. Cooper is one of the few fully qualified Quaternary geologists practicing full time consulting in Canada. He has carried out mapping of the Quaternary for a number of areas in Canada, but the majority of his experience has been in Ontario.

As a geologist with the Ontario Geological Survey between 1973 and 1979, Mr. Cooper gained valuable experience related to the stratigraphy and location of a variety of geological units within the province.

Mr. Cooper's strong background in geology, and particularly Quaternary geology, is very valuable in determining the significance of the geological history of an area and its relationships to hydrogeology and engineering geology.

Mr. Cooper is a member of four professional geological societies and is the author of more than 40 government maps and reports.

Number/
Numéro

Gartner Lee Associates Limited

Consulting Engineering Geologists and Hydrogeologists

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STUDY OUTLINE

PRIMARY ENVIRONMENTAL INFORMATION

PART 2

SURFACE WATER INVENTORY

FOR

FACILITIES DEVELOPMENT PROCESS

ONTARIO WASTE MANAGEMENT CORPORATION

JUNE, 1982

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1.0 INTRODUCTION:

1.1 BACKGROUND:

The Ontario Waste Management Corporation (OWMC) is currently involved in the first phase of study in its Facilities Development Process. This phase of the process deals with the *inventory* of basic engineering, environmental and planning information upon which development of a hazardous liquid industrial waste and other hazardous waste treatment facility is largely dependent.

This study outline describes one component of primary environmental information which is being collected. It deals with an inventory of fundamental surface water information which is basic to understanding significance of liquid effluents discharged to the *aquatic* environment. It complements a geological/hydrogeological inventory which is basic to understanding the significance of disposal of solid residues in the *terrestrial* environment and an inventory of climatological information, basic to an understanding of behaviour of emissions to the *atmospheric* environment.

1.2 STUDY OBJECTIVES:

Normal practice in Ontario is to treat the bulk of municipal and industrial wastes by a combination of physical, chemical

and biological treatment processes. The resultant treated wastewater is often discharged to provincial lakes or rivers with the bulk of waste constituents removed. It is likely that the ultimate facility developed by OWMC will include a liquid treatment capability and will involve discharge of a high quality effluent directly or indirectly to the surface water environment.

To determine the acceptability of this practice in particular receiving water bodies, certain basic information must be considered. This information relates to:

(i) the natural capability of the receiving environment to assimilate/disperse/dilute a liquid effluent,

(ii) the predictability of the behaviour of the emission in the receiving environment,

(iii) the important uses of surface waters nearby.

With this framework in mind, the objective of this study is to

> *document basic surface water information which relates to the natural capability of the river or lake to receive highly treated wastes and avoid interference with existing uses.*

Considered along with other primary environmental, engineering and planning information, these surface water data

will be useful in identifying feasible facilities options.

1.3 SCOPE:

This study is general in scope and data are presented on a provincial scale. The inventory will apply to southern Ontario -- i.e. south of North Bay.

It is the second study dealing with the collection of Primary Environmental Information, the other being the Geological/Hydrogeological inventory for Southern Ontario.

Some basic information on liquid effluent volume to be discharged is being analyzed at present, making it difficult to portray the large amount of available data in a simple yet meaningful fashion. However, in the general context of the primary information inventory, assumptions which have been made (for example, on volume of liquids to be treated) are not expected to create problems at this first stage.

2.0 DESCRIPTION OF TASKS:

The surface water inventory will build on a base of published and readily available information which will be

interpreted and presented by experienced staff familiar with surface water management and specifically with the discharge of liquid effluents to surface water receivers. Tasks involve:

- an inventory of significant uses
- an inventory of general streamflow and lake current information
- preparation of a report

2.1 Major Water Uses:

By referring to published information, surface water uses of major importance will be inventoried and plotted on maps.

Surface water uses which are regarded as having greatest significance as far as discharge of a liquid effluent is concerned are:

- municipal water intakes
- public beaches
- near-shore spawning areas of the Great Lakes
- important inland spawning areas
- municipal/industrial effluent discharges to surface waters

Published provincial and federal government reports and technical publications will provide the bulk of water use information. Contact will be made with key staff within the Ministry of the Environment (MOE) and Ministry of Natural Resources (MNR) and the International Joint Commission (IJC). Already, much of this information has been

gathered by The Proctor & Redfern Group in their land use study which will facilitate data acquisition.

2.2 STREAMFLOW AND NEAR-SHORE CURRENTS:

Important to the dilution, assimilation and dispersion of a liquid effluent are the streamflow and prevailing current characteristics of the river or lake receiving the discharge.

Our hydrologist will use published information on streams where monitors exist, to inventory the critical low-flow characteristics of southern Ontario streams. Where long-term hydrological data exists, low-flow will be expressed as, "$_7Q20$" which is the 7-day low flow that, on the average, occurs once in 20 years. Where a shorter period of record exists, flow will be expressed in terms of "99% duration" which indicates the daily flow that was equalled or exceeded 99% of the time during the period of record. Data will be expressed in streamflow ranges (0-5000 Litres/second) which will allow easy translation into dilution ratios for a 10 L/s to 50 L/s (roughly 200,000 gallons per day to 1 Million gallons per day) treatment facility.

Prevailing near-shore currents on surface and at depth will be documented for the Canadian near-shore waters of Lakes Ontario, Erie, St. Clair and Huron (including Georgian Bay) and of Lake Simcoe if information is available. This information will be plotted at a lake-scale level of detail to portray general current directions and will

be related to pertinent surface water uses such as major wastewater outfalls and major municipal intakes. Findings will be important in providing a preliminary indication of the fate of a high quality effluent.

Lake currents information is available in IJC - sponsored reports of the MOE, Canada Centre for Inland Waters (CCIW), and from Ontario and other Great Lakes research agencies. While more detailed work has been done on major effluent discharge points, it is too early to address these at this early stage of information gathering. This information will be gathered but time spent on its interpretation will be more effectively devoted during the second phase of the Facilities Development Process (i.e. evaluation).

2.3 Reporting:

Maps showing important water use locations, general stream-flow characteristics and overall current patterns in near-shore areas of the Great Lakes and Georgian Bay and Lake Simcoe, will be prepared. These maps will serve as the basis for the report.

The written text will include a description of the purpose and scope of the study, the study approach, a summary of pertinent findings and a list of pertinent references which were used and those which will be useful in later levels of study. Significance of the surface water uses, flow and near-shore lakes processes information to discharge of possible liquid emissions into the aquatic

environment will be described.

A draft copy of the report will be submitted for review by the Client and once comments on the draft are received, the report will be finalized. At this time, the number of copies required is unknown; hence, our reporting cost estimate is approximate and may be subject to change after required numbers are known.

3.0 STUDY TEAM:

The surface water portion of environmental information being collected will be coordinated by David S. Osmond, B.Sc., Agr. of Gartner Lee Associates Limited. Dave has 15 years experience in the surface water management field as a water pollution biologist, and later as Surface Water Evaluator and Chief of the Water Resources Assessment Unit of the Southwestern Region of the Ministry of the Environment. He has supervised an inter-disciplinary team of hydrologists, biologists and engineers who addressed capabilities of surface waters to accept treated wastewater. He is well aware of the various study components which are important at this primary level of information gathering.

Jamie J.P. MacLean, M.Sc., B.E., B.Comm. is a hydrologist with Gartner Lee Associates Limited. He has worked in the hydrological field for roughly four years. Jamie has

direct experience which includes streamflow monitoring and installation of stream gauging stations. He is conversant with standard methods of expressing streamflow information and understands the limits to which the data may be interpreted. Jamie will be primarily responsible for the streamflow inventory portion of this primary information gathering phase of the Facilities Development Process.

Other members of staff will be assigned to this project as available and as required. Their involvement will be merely to locate existing information and transfer it onto common base maps under Mr. Osmond's direction.

In recognition of the need for an expert in the lake currents/dispersion field early in the Facility Development Process, we have retained Merv D. Palmer, Ph.D. of Gore & Storrie Limited. Merv has extensive experience in near-shore Great Lakes current and dispersion studies and is well qualified to address behaviour of liquid emissions to lakes and rivers. Merv will be supported by 3 members of his staff at Gore & Storrie Limited - Hal Gowda, Ph.D. (water resources engineer), Ray Dewey, Ph.D. (limnological modeller) and Fraser Smith, B.Sc. (mathematical modeller). Merv and his study team will report through Mr. Osmond.

Curricula vitae for Gartner Lee Associates Limited and Gore & Storrie Limited staff involved in this project are enclosed.

DAVID S. OSMOND

B.Sc., Agr.

Aquatic Biologist

PROFILE

1963-1967	- B.Sc. (Agr.) - University of Guelph - Honours Zoology
1967-1969	- Biologist - Ontario Water Resources Commission (Toronto)
1969-1974	- Regional Biologist - O.W.R.C. and Ontario Ministry of the Environment (London)
1974-1976	- Chief, Water Resources Assessment - Ontario Ministry of the Environment - Southwestern Region
1976-1978	- Aquatic Biologist - Gartner Lee Associates Limited
1978-1981	- Senior Biologist - Gartner Lee Associates Limited
1981-Present	- Associate - Gartner Lee Associates Limited

EXPERIENCE

Since graduation in 1967, Mr. Osmond has gained enviable experience in water pollution biology and the water resource assessment and watershed management fields. This experience was acquired first-hand as a field biologist and manager of a multidisciplined water resource assessment team with the Ministry of the Environment and as a consultant with Gartner Lee Associates Limited. His responsibilities as a water pollution biologist involved the investigation of effects of various contaminants on aquatic life. Fish kill investigations, studies of effects of industrial and municipal waste discharge and land use practices on fish and fish-food organisms have been the main thrust of his experience. As well, Mr. Osmond has been actively involved in environmentally sensitive areas mapping projects for a number of clients. He has written and co-authored several reports on watershed studies, water pollution impact studies, environmental sensitivity investigations along with water quality-biological studies of the near-shore waters of the Great Lakes.

AFFILIATIONS

• North American Benthological Society • Canadian Society of Environmental Biologists • American Society of Limnology and Oceanography • Pollution Control Association of Ontario • Ontario Association of Environmental Management • British Ecological Society

JAMES J. P. McLEAN
M.S., B.E., B. Comm.
Hydrologist

PROFILE

1973-1978	B.E. (Honours), Lincoln College, New Zealand, Agricultural Engineering
1974-1979	B. Commerce, University of Canterbury, New Zealand, Operations Research.
1978	Engineering Assistant, New Zealand Department of Agriculture
1979	Hydrological Technician, Hawkes Bay Catchment Board, Napier, New Zealand
1980-1981	M.S., Ohio State University, Hydrology
1981-Present	Hydrologist, Gartner Lee Associates Limited

EXPERIENCE

Mr. McLean has obtained experience in several aspects of surface water hydrology and hydrogeology. These include surface water flow determination, subsurface drainage and aquifer performance. His involvement with sanitary landfills and industrial waste disposal has dealt with streamflow and leachate studies, and site investigation. Mr. McLean has obtained practical knowledge of drilling, associated geotechnical testing procedures and monitor installation.

STEVEN J. USHER, P. Eng.
B.Sc.
Civil Engineer

PROFILE

1975-1979	- B.Sc. - Queen's University, Civil Engineering
1977	- Laboratory Soils Technician - Ontario Ministry of Transportation & Communications
1978	- Field Soils Technician - Klohn Leonoff Consultants Limited (Calgary)
1979-1981	- Junior Engineer - Gartner Lee Associates Limited
1982	- Course - University of Alberta, J.D. Mollard - Air Photo Interpretation
1981-Present	- Project Engineer - Gartner Lee Associates Limited

EXPERIENCE

Mr. Usher has worked for Gartner Lee Associates since his graduation from Queen's University and is a registered professional engineer. He has developed a blend of geotechnical and hydrogeological experience that has proved valuable in field investigations combining both disciplines.

Steve has general experience in the hydrological field having conducted streamflow measurements as part of several landfill studies. His engineering training in hydrology has since been augmented by a drainage engineering course at the University of Guelph.

- Association of Professional Engineers of Ontario
- Canadian Geotechnical Society
- Canadian Society of Civil Engineers
- Engineering Institute of Canada

Merv D. Palmer, Ph.D.

PROFESSION: Scientist

POSITION IN FIRM: Manager

SPECIALIZATION IN FIRM: Water quality assimilation measurements and computer predictions, environmental assessments, periodic taste & odour problems

Commenced Work with Gore & Storrie Limited, September, 1978

KEY QUALIFICATIONS & EXPERIENCE

1978 - Present Manager, Water Resources Division, Gore & Storrie Limited.

Recent projects are as follows:

1. Environmental Impact Assessments

Outfalls (Location & Design)
- Stelco at Nanticoke (1.1 cu.m/s) Lake Erie
- Clarkson on Lake Ontario (5.5 cu.m/s)
- Cooling water Nanticoke (160 cu.m/s)
- Keswick on Lake Simcoe (0.56 cu.m/s)

Dams
- Glengowan, Thames River, London, Ontario

2. Assimilative Studies

- South Saskatchewan River near Saskatoon (indicator bacteria, nutrients and dissolved oxygen)
- Rideau River near Ottawa (indicator bacteria)
- Whitson River near Sudbury (dissolved oxygen)
- Georgetown, Rogers Creek (ammonia)
- St. John's harbour, Newfoundland (bacteria)
- Tejo Estuary, Portugal (indicator bacteria and metals)
- Ottawa River beaches (indicator bacteria)

3. Assimilative Studies

- Lakeview on Lake Ontario (5.3 cu.m/s)
- Niagara Falls (5.3 cu.m/s)
- Ajax (0.66 cu.m/s)

3. Treatment Mashes. Listowel

4. Field Experience

Any environmental model requires modification and tuning to represent environmental systems. The appropriate field data collection program and interpretation of the environmental systems is the most important factor in evolving representative models. Specialized field survey programs have been designed and executed and then used to adjust

predictive models in the St. John's, Tejo Estuary, Lakeview, Rideau River, Whitson River, Glengowan dam and Nanticoke studies.

1967 - 1978

Program Engineer in charge of the Lake Systems Group, Ontario Ministry of the Environment. The group is responsible for operating recording automatic chemical and physical environmental response models which are used for water management programs. A major task is the measuring of loadings from streams and sewers to the coastal waters, using recording devices.

Collecting and analysing continuously recorded currents, temperatures and water quality data is an important component for modelling and verifying time varying environmental systems.

1964 - 1966

Hydraulics Engineer with James F. MacLaren, Consulting Engineers, Toronto.

1959 - 1963

Royal Canadian Engineers

EDUCATION:

Ph.D. Fluid Mechanics, 1971
University of Toronto

LANGUAGE(S):

English

PROFESSIONAL AFFILIATIONS:

Editorial Board of the Journal of Great Lakes Research
and Proceedings of Water Pollution Research in Canada
Water Quality Committee for American Geophysical Union
Association of Professional Engineers of Ontario
Association of Professional Engineers of Newfoundland
American Water Pollution Control Federation
American Geophysical Union
Canadian Meteorological and Oceanographical Society
Canadian Water Resources Association
American Society of Limnology and Oceanography

T.P. Halappa Gowda, Ph.D.

PROFESSION: *Water Resources Engineer*

POSITION IN FIRM: *Water Resources Consultant*

SPECIALIZATION IN FIRM: *Water Quality and Hydraulic Studies - Measurements, Computer Modelling and Environmental Assessments for Natural Water Bodies*

Commenced Work with Gore & Storrie Limited, January 1982

KEY QUALIFICATIONS AND EXPERIENCE

1982 - Present *Senior Water Resources Consultant, Water Resources Division, Gore & Storrie Limited, Toronto*

Whitson River Wastewater Assimilative Capacity Study (Dissolved oxygen, ammonia & Chlorine)

Glengowan Environmental Assessment - Water Quality Assessment Studies (Impact of flow augmentation from dams on the dissolved oxygen regime of the Thames River).

1974 - 1982 *Water Quality Engineer and Specialist, Water Resources Branch, Ontaio Ministry of the Environment, Toronto.*

Major Projects are as follows:

1. *Mixing Zone Studies*

Project Leader and principal investigator responsible for model development and application.

Municipal Discharges: Mixing zone model application to predict chlorine and ammonia in: Grand River below Waterloo, Kitchener, Galt and Brantford, Speed River below Guelph, Avon River below Stratford and Cobourg Brook below Cobourg. Planning and execution of field studies required to collect data for mixing zone model calibration and verification.

Industrial Discharges: Mixing zone studies of the CIP Pulp and Paper Mill effluent in the Ottawa River at Hawkesbury. Dispersion of Uranium mine tailing wastewaters in the Stollery Lake-Serpent River System, Elliott Lake, Northern Ontario.

2. *River Basin Studies*

Stratford-Avon River Environmental Management Project: Project Leader responsible to develop and apply water quality models, particularly for nutrient transport; and assessment of the effectiveness of oxygen injection, weir aeration and biomass cropping on instream oxygen levels through pilot and full-scale demonstration studies in the river and by modelling; and planning execution of

specialized field investigations.

Grand River Basin Water Management Study: Project Leader responsible for waste load allocation using dissolved oxygen modelling techniques including direct measurement of reaeration, river water quality effects of stormwater, continuous monitoring of water quality and instream measurements and prediction of the effects of nitrification.

1972 - 1974 — Special Lecturer & Research Associate, University of Ottawa, Ottawa.

Transverse dispersion and water quality studies in the Ottawa River carried out as part of the project on transport of mercury and pesticides undertaken jointly by the University of Ottawa and National Research Council of Canada; and teaching graduate and undergraduate courses in water resources and environmental engineering.

1967 - 1972 — Research and Teaching Assistant, University of Ottawa, Ottawa.

Dye-dispersion studies in a 100 km stretch of the Ottawa River. Research on diffusion in the wake of a self-propelled boat through full-scale field studies and modelling.

1962 - 1967 — Lecturer in Civil Engineering, Malnad College of Engineering, Hassan and Siddaganga Institute of Technology, Tumkur, India.

EDUCATION:

Ph.D. Water Resources 1972, University of Ottawa
M.E. Public Health 1964, University of Calcutta, India
B.E. Civil Engineering 1961, University of Mysore, India

PROFESSIONAL AFFILIATIONS:

Association of Professional Engineers of Ontario
Canadian Society for Civil Engineering
Engineering Institute of Canada
American Society of Civil Engineers
American Water Resources Association

Raymond J. Dewey, Ph.D.

PROFESSION: *Applied Mathematician*

POSITION IN FIRM: *Applied Mathematician-Water Resources Division*

SPECIALIZATION IN FIRM: *Mathematical Modelling, Limnology & Oceanography*

Commenced Work with Gore & Storrie Limited, June 1980

KEY QUALIFICATIONS & EXPERIENCE

1980 - Present

Applied Mathematician, Water Resources Division, Gore and Storrie Limited. Responsibilities involve developing computer and mathematical models to be used for management purposes and for environmental impact assessments.

Major projects include:

Development of Stochastic river water quality model, lake assimilative capacity model.

St. John's Nfld harbour assimilation study, Development of wind and current surface transport models, Development of two-dimensional tidal harbour model for fecal Coliforms, Analysis of Dye tracing and current meter survey data.

Environmental Impact Assessments

Outfalls (Location & Design)
- *Clarkson (Lake Ontario, Staged diffuser 5.5m^3/s)*
- *Keswick (Cook Bay, Staged diffuser 5m^3/s)*
- *Cornwall (St. Lawrence River, Co-Flowing diffuser 1.4m^3/s)*

Glengowan Environmental Assessment involving water quality predictions of the Thames River.

Senior Systems & Programming Analysis of Gore & Storrie Computer System.

1972 - 1980

Research and teaching experience at the University of Western Ontario. Research projects for 1973-1980 include:

Experimental determination of particle dispersion in turbulent flows; Extensive computer modelling and simulation of turbulent flow situations; Data acquisition and analysis on digital and analogue computers and solution of certain non-linear differential equations by numerical analysis on digital computers.

PUBLICATIONS:

1982 Longitudinal dispersion at small times, Co-authored with Dr. P.J. Sullivan; J.F.M., in review.

1981

The Aspect-Ratio Effect on Dispersion in Turbulent Channel Flow. Co-authored with Dr. P.J. Sullivan; presented at the Canadian Conference of Applied Mechanics, CANCAM,

University of Moncton, New Brunswick, June 1981, in print Trans. CSME

1979

Ph.D. Thesis - Some aspects of non-stationary Turbulent Dispersion.

Diffusion in Diverging and Converging Channels, Co-authored with Dr. P.J. Sullivan, Vol.5 No.3. Transactions of the CSME Presented at CANCAM 1979, University of Sherbrooke, May 1979.

1977

The Asymptotic Stage of Longitudinal Turbulent Dispersion in a Tube, Journal of Fluid Mechanics, Vol.80, P.293. Co-authored with Dr. P.J. Sullivan.

Longitudinal Dispersion in Flows that are Homogenous in the Streamwise Direction, Zamp Vol.30, 601. Co-authored with Dr. P.J. Sullivan. Presented at the Canadian Conference of Applied Mechanics CANCAM, University of British Columbia, May 1977.

1975

M.Sc. Thesis - Asymptotic Dispersion in a bounded Turbulent Shear Flow.

Time Scales Relevant to an Asymptotic State of Dispersion. Presented at CANCAM 1975, University of New Brunswick, Fredericton, May.

1974

The Approach to the Final Stage of Dispersion in a Turbulent Shear Flow. Presented at ASME-CSME Fluid Engineering Conference, Montreal, May.

Published in Transaction of the CSME. Vol.5, P.55 1975

EDUCATION:

Ph.D. University of Western Ontario,
Applied Mathematics - 1979
M.Sc. University of Western Ontario,
Applied Mathematics - 1975
B.Sc. University of Western Ontario,
Applied Mathematics - 1973
Private Pilot Licence

LANGUAGE(S): English

PROFESSIONAL AFFILIATIONS:

Canadian Society of Mechanical Engineers
International Association of Great Lakes Research

Fraser B. Smith

PROFESSION: *Applied Mathematician*

POSITION IN FIRM: *Mathematician & Programmer, Water Resources Division*

SPECIALIZATION IN FIRM: *Mathematical Modelling and Data Analysis*

Commenced Work with Gore & Storrie Limited, June 1980

KEY QUALIFICATIONS & EXPERIENCE

1980 - Present *Mathematician & Programmer, Water Resources Division, Gore & Storrie Limited.*

Responsibilities involve computer and mathematical modelling for environmental impact assessment and statistical analysis of environmental data.

Major projects are as follows:

1. *Environmental Impact Assessments*

Outfalls
- *Clarkson on Lake Ontario (5.5 cu.m/s)*
- *Keswick on Lake Simcoe (0.56 cu.m/s)*

Dams
- *Glengowan, Thames River, London, Ontario*

2. *Assimilative Capacity Studies*

- *Rideau River near Ottawa (indicator bacteria)*
- *St. John's Harbour, Newfoundland (bacteria)*
- *Ottawa River beaches (indicator bacteria)*
- *Whitson River near Sudbury (dissolved oxygen)*

EDUCATION: *B.Sc. Honours - Applied Mathematics*
University of Western Ontario - 1980

Additional courses in Biology,
London, Ontario.

LANGUAGE(S): *English*

PROFESSIONAL AFFILIATIONS: